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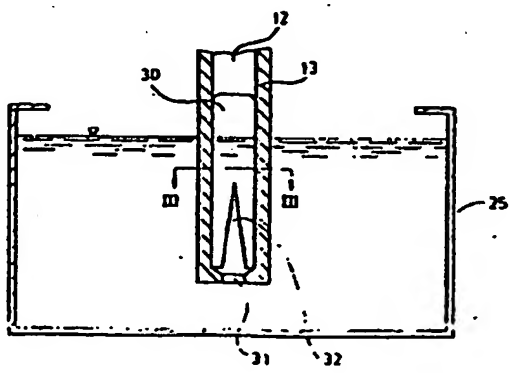
(54) Maintaining liquid level in a centrifugal separator.

(57) In order to subject a valve (7) within the rotor of a centrifugal separator to a certain liquid pressure, a chamber (9) on one side of the valve is connected to an axial channel (12) in the vertical drive shaft (13) of the rotor, and a liquid surface is maintained in the channel very close to the axis of the rotor during the operation of the rotor. At the lower end of the drive shaft, the channel (12) opens axially though an orifice (31) having its edge at the desired radial level for the liquid surface, and this end of the shaft is arranged to rotate in a liquid body in a container (25) below the drive shaft (13).

Fig.2



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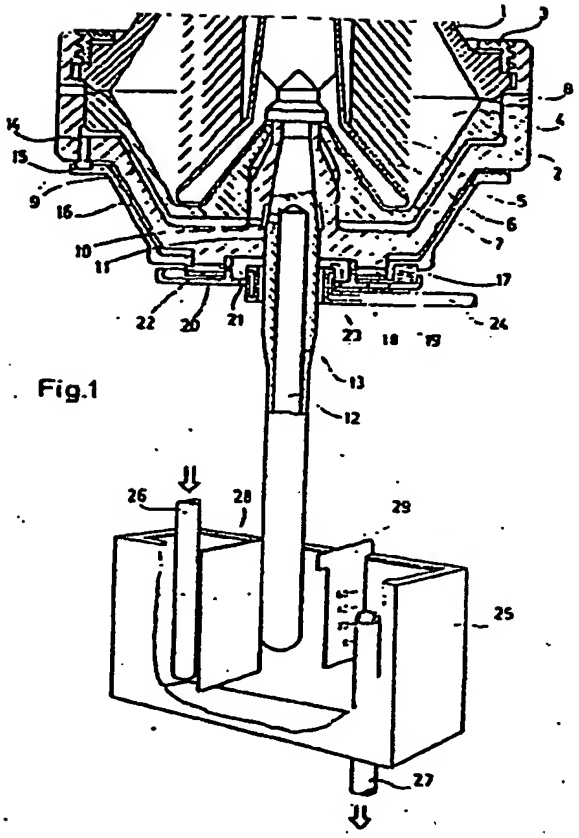

Fig.1

Maintaining liquid level in a centrifugal separator

This invention relates to centrifugal separators, and in particular centrifugal separators in which a rotor is supported by a vertical drive shaft. The invention is concerned with a method of and a device for maintaining the surface of a liquid body in the rotor at a radial level very close to the rotor axis to subject a valve in the rotor to a predetermined liquid pressure.

There are known centrifugal separators with rotors having intermittently openable outlets. An axially movable annular slide valve is often arranged in the rotor for opening and closing of the outlets, and is hydraulically actuated in a closing direction by means of a liquid body maintained in a chamber in the rotor during its rotation. In a common rotor design the slide valve forms a movable wall between the separation space of the rotor and said chamber. The chamber is often called a "closing chamber", and the liquid supplied to the closing chamber is often called "closing liquid".

The liquid body, i.e. the closing liquid, which is maintained in the closing chamber, has during rotation of the rotor a surface which faces the rotor axis and is situated at a certain distance therefrom. This distance is of significance for determining the liquid pressure exerted by the closing liquid on the slide valve. A smaller distance means a greater liquid pressure on the

slide valve.

The liquid pressure exerted on the slide valve by the closing liquid must overcome the pressure exerted on the slide valve by the liquid in the separation space of the rotor, in order that the slide valve should keep the outlets from the separation space closed. Since the liquid in the separation space will in certain cases be heavier than the closing liquid, usually water, it may be desirable to maintain the surface of liquid in the closing chamber as near to the rotor axis as possible. This may sometimes be desirable from other points of view also.

Closing liquid is normally supplied to the closing chamber through a stationary pipe extending parallel with the rotor drive shaft into the rotor, where it opens into an annular groove. The groove is open radially inwards towards the rotor axis and communicates radially outwards with the closing chamber. The radially innermost position of the liquid surface of the coherent liquid body filling the closing chamber and the supply groove is limited to the fact that room must be left for the stationary supply pipe between the rotor drive shaft and the liquid surface.

For cases where an even higher liquid pressure must prevail in the closing chamber than can be achieved by means of the known arrangement described above, another arrangement is known for the supply of closing liquid. The closing chamber is connected directly with an axial channel in the rotor drive shaft. The lower end of the channel is connected via a mechanical seal with a channel in a stationary conduit for supply of pressurized closing liquid. By such an arrangement a substantially higher pressure can be achieved in the closing chamber.

However, the need for a mechanical or other kind of seal between the rotor drive shaft and a stationary conduit for the supply of closing liquid is a drawback as

the seal may become worn and have to be replaced. In certain connections, e.g. marine separators, this is considered to be an appreciable inconvenience, which should be avoided. Besides, an arrangement of this kind is sometimes over-qualified regarding the possibility of supplying closing liquid to the rotor at super-atmospheric pressure. In many cases it would suffice that the free liquid surface of the liquid body in the closing chamber be located somewhat closer to the rotor axis than is possible when closing liquid is supplied through an open groove within the rotor.

The present invention aims to fulfil the need explained above, avoiding a mechanical seal, and enabling the surface of a liquid body present in the rotor to be maintained at a radial level very close to the rotor axis.

According to one aspect the invention provides a method of maintaining the surface of a liquid body in the rotor of a centrifugal separator at a given radial level to subject a valve in the rotor to a predetermined liquid pressure, the rotor having a vertical drive shaft, characterised in that during rotation of the rotor a liquid surface is created within a channel extending axially through said drive shaft and communicating with the rotor, the lower end of the channel opening axially through an orifice into a body of liquid below the rotor, and the orifice having a peripheral edge located at said given radial level.

During the operation of the rotor, the cylindrical liquid surface within the channel in the rotor drive shaft is not permitted to move radially inside the edge of the orifice through which the channel opens into the body of liquid, and the surface remains at the desired level as long as the end of the drive shaft is kept rotating in the liquid. Liquid is permitted to flow into the channel during rotation of the rotor, so as to form

the cylindrical liquid surface within the drive shaft and until the surface has moved radially inwards to the level of said edge. After that, the same edge will maintain the level of the cylindrical liquid surface within the drive shaft.

In accordance with a second aspect the invention provides a device for maintaining the surface of a liquid body in the rotor of a centrifugal separator at a given radial level to subject a valve in the rotor to a predetermined liquid pressure, the rotor having a vertical drive shaft, characterised in that an axial channel in the drive shaft communicates with a chamber within the rotor, and the channel opens axially into a liquid container below the rotor through an orifice having a radius less than that of the channel.

A full understanding of the invention will be had from the following detailed description which is given with reference to the accompanying drawings, wherein:-

Figure 1 is an axial section through the lower part of the rotor of a centrifugal separator and showing also a container for liquid situated below the rotor;

Figure 2 shows, in section, the liquid container of Figure 1 and the lower end portion of the rotor drive shaft; and

Figure 3 shows a section taken along the line III-III in Figure 2.

The centrifuge rotor shown in Figure 1 comprises two parts 1, 2 which are kept together axially by a lock ring 3. Within the rotor there is formed a separation space 4, in which a set of conical separation discs 5 are located. The discs 5 rest on the lower part of a distributor 6 adapted to distribute liquid, centrally received in the rotor, evenly to different parts of the separation space 4.

An axially movable slide 7, forming the bottom of

the separation space 4, abuts the rotor part 1 with its annular rim portion, whereby the separation space 4 is closed from communication with a number of peripheral outlets 8 formed in the rotor part 2.

Between the slide 7 and the lower rotor part 2 there is formed a chamber 9 intended to contain so-called closing or operation liquid, usually water. The chamber 9 communicates through openings 10 and 11 with a channel 12 formed centrally in a shaft 13. The shaft 13 is rigidly connected with the rotor part 2 and constitutes the rotor drive shaft, a driving device, not shown, being provided for driving the shaft 13. Furthermore, the drive shaft is journalled in a way not shown in the drawing.

At its circumference the lower rotor part 2 has a number of axial through bores 14 intended to serve as outlets for operation liquid from the chamber 9. The bores 14 are normally covered at the outside of the rotor body by closing members 15 carried by an axially movable, so called operation slide 16. The operation slide 16 is actuated to a closing position of the closing members 15 by means of coil springs 17 arranged between the operation slide 16 and a support plate 18 rigidly connected with the rotor part 2.

The radially innermost part of the operation slide 16 forms together with the rotor part 2 an additional chamber 19 for operation liquid. The chamber 19 has a central inlet in the form of a large number of openings 20 in a wall forming the bottom of an annular groove 21 which is open radially inwards. The chamber 19 has one or a few outlets 22 in its radially outer wall. The inlets 20 and outlets 22 are dimensioned such that, during operation of the rotor, liquid can flow faster into the chamber 19 than it can leave the chamber.

An annular supply member 23 connected to a conduit

24 is provided for intermittent supply of liquid to the groove 21.

The rotor drive shaft 13 extends down into an upwardly open container 25. This has a supply pipe 26 and a drain pipe 27 for liquid. The upper end of the drain pipe 27 forms an overflow outlet for liquid in the container, so that a certain liquid level is maintained therein. To counteract rotation of the liquid in the container 25, caused by the rotor drive shaft 13, there are a number of baffles formed by flanges 28, 29 in the container. Additional flanges for the same purpose could be provided in various ways in the container 25.

In Figure 2, the container 25 is shown with the flanges and pipes omitted, but containing liquid. The liquid level is indicated by a small triangle. The lower end portion of the rotor drive shaft 13 is also shown.

As can be seen from Figures 2 and 3, an entrainment blade 30 is provided within the channel 12 of the drive shaft. The channel 12 opens axially into the interior of the container 25 through a central hole 31 having a diameter which is smaller than the diameter of the channel 12. The blade 30 has a slot 32 opposite to the hole 31.

The above described device is intended to operate in the following manner.

When the drive shaft 13 is rotated, a cylindrical liquid surface will be formed within the channel 12 and liquid will flow upwards along the walls of the channel 12 and out through the openings 11 and 10 to the chamber 9 in the rotor. New liquid flows into the channel 12 through the hole 31. When the chamber 9 is filled with liquid, the liquid flow in through the hole 31 will cease, and the cylindrical liquid surface in the channel

12 will be positioned at the radial level of the edge surrounding the hol 31. This radial level is very close to the axis of the rotor and will determine the liquid pressure which prevails in the chamber 9 and which, among other things, exerts a closing force against the underneath side of the slide 7.

The force exerted against the underside of the slide is larger than the force in the opposite direction and exerted against the upper side of the slide 7 by liquid present within the separation space 4. Thus, the peripheral outlet openings 8 are kept closed. When the outlet openings 8 are to be opened, liquid is supplied through the pipe 24, the supply member 23, the groove 21, and the inlets 20 to the chamber 19. The liquid pressure created in the chamber 19 overcomes the force of the springs 17 acting on the operation slide 16, and the slide 16 is moved axially downwards so that the outlet openings 14 from the chamber 9 are uncovered.

Thereby, liquid is allowed to leave the chamber 9 at a higher speed than new liquid can be supplied to this chamber through the channel 12 in the drive shaft, and slide 7 then moves downwards and uncovers the outlet openings 8 from the separation space 4.

When the liquid flow through the pipe 24 to the chamber 19 is interrupted, this chamber is drained through the outlets 22, and the operation slide 16 returns to its upper position under the force of the springs 17 to close the outlets 14 from the chamber 9. The chamber 9 now begins to refill with liquid, which all the time has been flowing in through the openings 10, 11 from the channel 12. As soon as the pressure against the slide 7 from the liquid in the chamber 9 exceeds the pressure against the same from liquid in the separation space 4, the slide 7 returns to its upper position, in which the outlet openings 8 are closed.

After the reclosing of the outlets, as well as before their opening, the liquid level in the channel 12 of the drive shaft is automatically maintained as previously described.

If desirable, the lower end portion of the drive shaft 13, i.e. the portion enclosing the blade 30, may be formed as a separate member, e.g. of plastics, which could be releasably connected to the rest of the drive shaft. Thereby, several such separate members may be produced with various sizes of the hole 31 for one and the same drive shaft.

Furthermore, if desirable, the part of the channel 12 in which the blade 30 is provided, may be given a greater diameter than that of the rest of the channel.

CLAIMS:

1. A method of maintaining the surface of a liquid body in the rotor (1,2) of a centrifugal separator at a given radial level to subject a valve (7) in the rotor to a predetermined liquid pressure, the rotor having a vertical drive shaft (13), characterised in that during rotation of the rotor a liquid surface is created within a channel (12) extending axially through said drive shaft (13) and communicating with the rotor, the lower end of the channel (12) opening axially through an orifice (31) into a body of liquid below the rotor, and the orifice having a peripheral edge located at said given radial level.

2. A device for maintaining the surface of a liquid body in the rotor (1,2) of a centrifugal separator at a given radial level to subject a valve (7) in the rotor to a predetermined liquid pressure, the rotor having a vertical drive shaft, characterised in that an axial channel (12) in the drive shaft (13) communicates with a chamber (9) within the rotor and the channel (12) opens axially into a liquid container (25) below the rotor through an orifice (31) having a radius less than that of the channel (12).

3. A device according to claim 2, wherein entrainment means (30) are provided in a lower end portion of the channel for entrainment of liquid upon rotation of the drive shaft.

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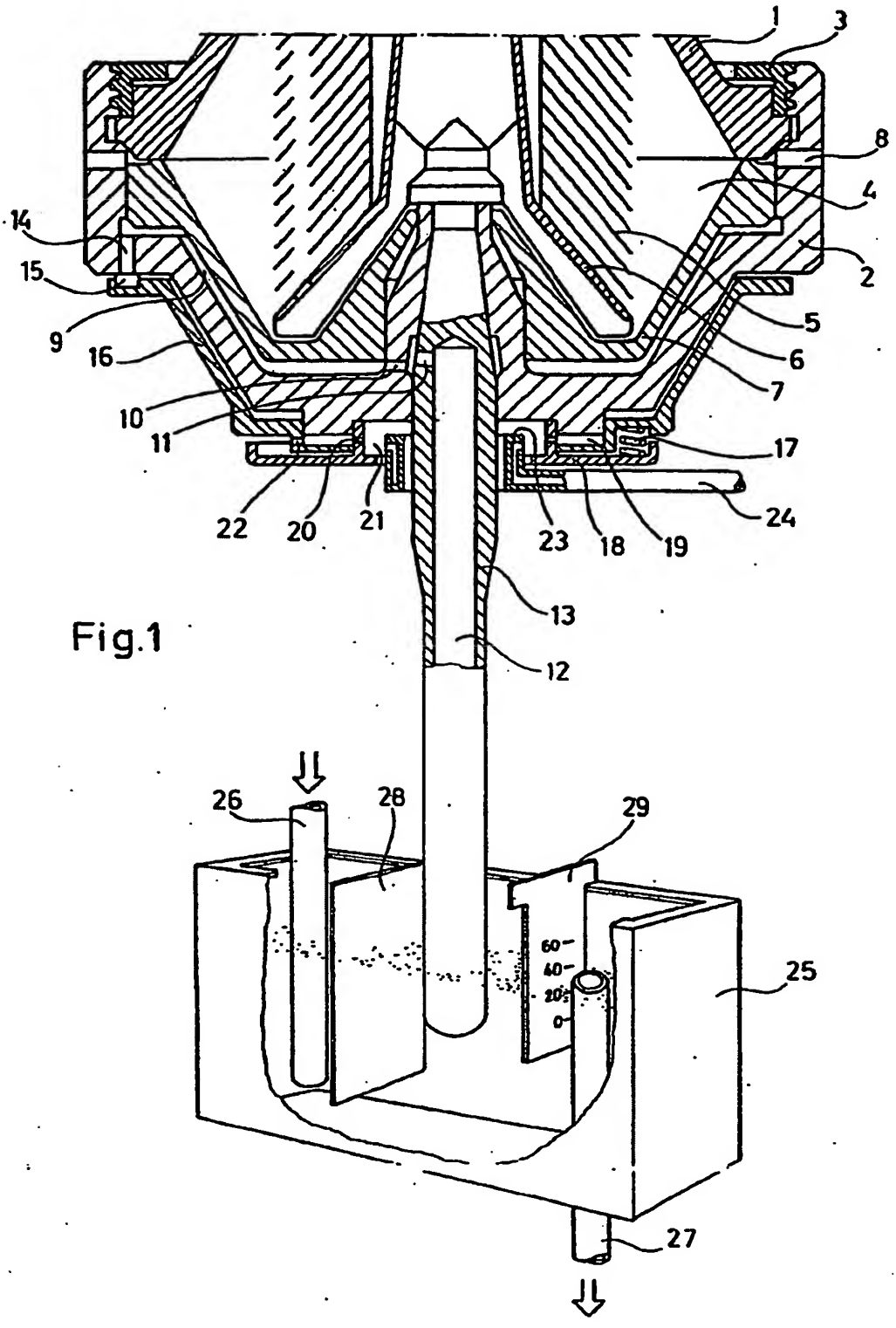

Fig.1

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Fig.2

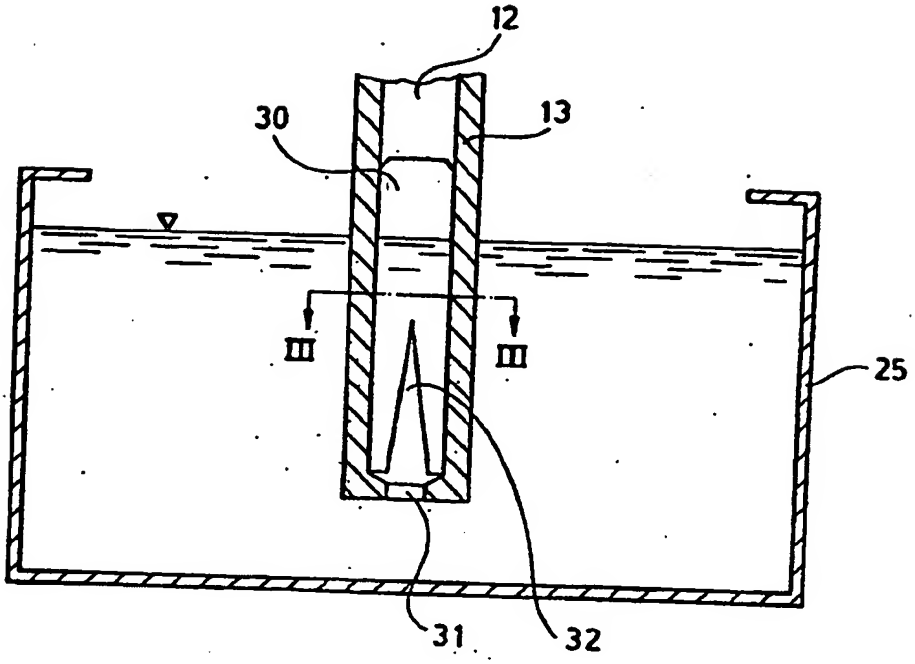
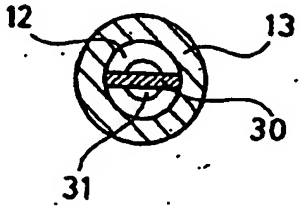


Fig.3



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EUROPEAN SEARCH REPORT

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Application number

EP 85303094.8

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl 4)
A	DE - A1 - 3 109 346 (KLÖCKNER-HUMBOLDT-DEUTZ) * Abstract; page 6, line 19 - page 8, line 9; fig. 1 * --	1,2	B 04 B 1/14 B 04 B 11/04
A	GB - A - 2 052 315 (ALFA-LAVAL) * Page 2, line 3 - page 3, line 1; fig. 1 * --	1,2	
A	US - A - 3 878 981 (WESTFALIA SEPARATOR) ----		

TECHNICAL FIELDS SEARCHED (Int. Cl 4)

B 04 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	09-09-1985	HAJOS

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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